N E W S L E T T E R

CLOVERS AND SPECIAL PURPOSE LEGUMES RESEARCH

Vol. 1--1967

Compiled by the Forage and Range Research Branch, Crops Research Division

Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland

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INTRODUCTION

The "Newsletter" is the result of a cooperative effort to bring together information on the improvement, production, and use of the many species of forage legumes other than alfalfa. Limited to intensive research is under way on one or more species of approximately 25 legume genera. We believe the informal exchange of research information on these many forage species is essential for maximum progress.

Reports are arranged by states rather than by species. This first issue may appear to be inadequate in that only a small amount of the research underway in the region is included. Further reports would tend to correct this situation. However, several have asked who is doing research, and where, on the various species, and the objectives and scope of the research. Such information, if supplied to us, could be added as a supplement in the next report, if this appears desirable.

Suggestions as to title, arrangement of articles, and other additions to the newsletter are always welcome.

Reports and other information for the next issue may be sent to Paul R. Henson, Newsletter, Room 333, South Building, Plant Industry Station, Beltsville, Maryland 20705.

ARKANSAS

Improvement and Testing of Winter Annual Legumes

M. S. Offutt (Fayetteville)

Objective: To obtain superior varieties and strains of winter annual legumes that are adapted to Arkansas conditions.

Winter hardy lines of white lupine (Lupinus albus) have been developed at Arkansas that have withstood winter temperatures as low as -10° F without a snow cover or other protection on well drained soils with less than 25 percent winterkill. During the winter of 1966-67, as much as 6,000 to 8,000 pounds per acre of dry matter were produced at Hope. Some of these lines contained as much as 200 pounds of nitrogen per acre in the forage at Hope (Southwest), 125 pounds per acre at Manila (Northeast), and 85 pounds per acre at Fayetteville. Some of these lines also averaged over 3,000 pounds of seed (50 bu.) per acre at Fayetteville. These lines are all rather high in alkaloids (bitter), but a program to incorporate the sweet characteristic (low alkaloid) into the winter hardy lines is underway. Within the material involved, the winter hardy character appears to be recessive, and the low alkaloid character to be partially dominant (the F_1 plants were intermediate between the two parents).

(Summary sheets of further details on performance of the winter hardy lines are available from author.)

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CANADA

M.C.H. Strain of Birdsfoot Trefoil

J. S. Bubar (Macdonald College, Quebec)

A strain of birdsfoot trefoil, designated M.C.H., has been distributed by the Department of Agronomy, Macdonald College. This was mass selected out of an introduction obtained from the All Union Plant Institute, Leningrad, U.S.S.R., in 1958. Mrs. A. C. Chamberlain (Classification of Agronomic Types in Lotus corniculatus L. and Related Species, M.Sc. thesis, Macdonald College of McGill University, 1961) classified this stock as quite similar to the Viking variety but distinct from it due to superior winter survival and some other morphological features. Further study indicates the M.C.H. stock is superior to Viking in seedling vigor, and it appeared in spaced plants and observation rows to excel in general plant vigor. Sufficient seed was produced in 1964 so that some small plot trials were seeded in 1965 (with seed designated M.C.H. 64) and some yield data were obtained in 1966. The data indicate that M.C.H. is at least equal to Leo and superior to Empire or Viking under Quebec conditions. Initiation of fall dormancy is at about the same time as Empire (i.e., later than Leo, earlier than Viking). Further mass selection has been carried out, and additional seed was distributed in 1966 and 1967.

Publications:

Miri, R. K. and J. S. Bubar. 1966. A technique for measuring incompatibility in Lotus corniculatus L. Crop Sci. 6:90-91.

Miri, R. K. and J. S. Bubar. 1965. Self-incompatibility as on outcrossing mechanism in birdsfoot trefoil (Lotus corniculatus). Canad. J. Plant Sci. 46:411-418.

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Cytogenetical and Chemotaxonomical Studies in Lotus

W. F. Grant (Macdonald College, Quebec)

A study has been initiated for the production of aneuploids and their use in cytogenetic analyses in Lotus. Two methods for the induction of aneuploids have so far been attempted. The first employs conventional hybridization techniques and has been more successful than our second method using irradiated pollen.

Our first aneuploids have been obtained from the hybrid L. pedunculatus (4x) x L. corniculatus. One plant with 23 chromosomes (monosomic) and four plants with an extra chromosome (2n = 13, trisomics) have been obtained. A total of 52 seedlings are now being grown from a cross between triploid and diploid L. pedunculatus and will be screened for aneuploids. The effects of aneuploidy on morphology and gene segregation are being determined.

We have so far been unsuccessful in producing aneuploids in L. corniculatus by means of irradiated pollen. To date, a total of 861 flowers from 4 different

strains have been emasculated and pollinated with pollen having received doses between 300 R and 8,000 R. Doses about 1,000 R have resulted in 80%, or higher, empty or shriveled seed.

Publications:

Grant, W. F. 1965. A chromosome atlas and interspecific hybridization index for the genus Lotus (Leguminosae). Canad. J. Genet. Cytol. 7: 457-471.

Grant, W. F. and Jennifer M. Whetter. 1966. The cytogenetics of Lotus. XI. The use of thin-layer chromatography in the separation of secondary phenolic compounds in Lotus (Leguminosae). J. Chromatog. 21:247-256.

Grant, W. F. and Ilse I. Zalite. 1966. Thin-layer chromatography in the separation of secondary phenolic compounds in Lotus (Leguminosae). J. Chromatog. 24:243-244.

Grant, W. F. 1966. Cyanogenetic glucoside distribution in the speciation of the genus Lotus and its evolutionary significance. Proc. XI. Pacific Science Congr., Tokyo, Abstracts Vol. 5 (Biology; Div. Meet. Bot.):38.

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Preventative Weed Control in Birdsfoot Trefoil Nurseries

B. E. Twamley and G. S. Anderson (Guelph)

The control of broadleaf and grassy weeds, annual and perennial, in space-planted legume nurseries has long been a problem. Traditionally the solution to the problem has been a resort to cultivation by machine and by the hand hoe. This practice, in addition to being laborious, may not be successful in destroying volunteer seedlings developing surreptitiously within the space occupied by the parent plant. While the use of 2,4-DB or dalapon is helpful, the greatest care must be exercised to prevent damage to the established nursery plants.

Preplanting treatment of the soil with EPTC is also helpful in weed control, but the beneficial effect does not extend beyond the year of establishment.

In recent years, the problem has been met at Guelph by spraying the nursery each year with simazine in the late fall after growth has stopped. The usual rate is one pound of active material per acre in 25 gallons of water. The results have been very satisfactory. Weed growth has been very largely prevented, volunteer trefoil seedlings have been destroyed, and the established trefoil plants in the nursery appear to have suffered little or no harm. No cultivation is normally required in the succeeding year.

The possibility of applying simazine to a nursery immediately after transplanting in the spring is now under investigation. Preliminary studies indicate that the young trefoil plants may require some kind of protection against the simazine. Various means of providing this protection through both physical and chemical means are currently being examined.

Publications:

Winch, J. E., G. W. Anderson, and T. L. Collins. 1966. Chemical renovation of roughland pastures. Proc. X Intern. Grassland Congr. pp. 982-7.

Twamley, B. E. 1966. Birdsfoot trefoil strain trial management. A preliminary report on a pilot study. Forage Notes 12(1):46-48.

Twamley, B. E. 1966. Birdsfoot trefoil strain trial management. A concluding report on a pilot study. Forage Notes 12(2): 32-33.

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GEORGIA

Summary of White Lupine (Lupinus albus L.) Breeding at Tifton, Georgia

Ian Forbes, Jr., and Homer D. Wells (Tifton),
and Robert E. Burns (Experiment)

Breeding white lupine for winter annual forage and cover crops was initiated in the 1951-52 winter at Tifton, Georgia. Crosses were readily obtained among a winterhardy, late-maturing accession (Experiment #1); the more vigorous, earlier, commercial bitter variety; Italian sweet, a low-alkaloid sweet variety; and Neuland (a low-alkaloid European variety). F_2 spaced-plant populations from these crosses varied in alkaloid content, maturity, vigor, and seed size. Selections were made for sweetness and large seed size, but the majority of the F_2 plants were killed or severely damaged by the lupine maggot, Hylemia lupini.

A study in 1953 to determine the best way for the breeder to produce flowers and seeds during the winter in the greenhouse included the treatments: seed vernalization, plant vernalization, diurnal temperature fluctuation, long and short photoperiods, and wave length of the dark period interruption light. The winterhardy accession (Experiment #1) was the white lupine used in this study (blue and yellow lupine were included, but are not discussed in this report). Plants vernalized by growing in the field for two months prior to being transplanted into the greenhouse under natural long nights in January produced an average of 14 seeds per 3 plants growing in a 6-inch pot by April 21. Such plants produced 16 seeds per pot when the dark period was interrupted for 2 hours at midnight by fluorescent light (100 F.C.) but produced only 7 seeds when a 1-hour interruption was provided with mazda light (200 F.C.). Providing diurnal temperature fluctuation by moving the plants outdoors for the night and moving them back to the greenhouse (70^{o} F minimum) each morning reduced seed set. None of the other treatments caused plants to set seed. Seed vernalization treatments might have been effective in producing seeds in the greenhouse if they had been carried out in early fall rather than in mid-winter as in this study.

In January 1966 and February 1967 all early-maturing European sweet varieties--Blanca, Gela Hansa, SSK-79, and Saatgut--winterkilled in the field (16.5^{o} F minimum). In both years plants of these varieties for use as parents were brought into flower by early April, by germinating seeds in the greenhouse in early February, then hardening the seedlings in a cold-frame for 2 weeks, and then transplanting them to the field about March 1.

In the late 1950's white lupine breeding at Tifton was placed on a standby basis because lupine maggot populations and damage made it less promising than blue lupine breeding. Recently, however, the lupine maggot has come under effective biological control by a parasitic fungus, Empusa sp. This development encouraged us to reactivate white lupine breeding with the objective of producing winter-hardy forage (low-alkaloid) varieties. Results in 1966-67 indicate that our F_1 plants from winterhardy, bitter x non-hardy, sweet crosses are intermediate to the parents for maturity and winterhardiness.

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Winterhardy Blue Lupine (Lupinus angustifolius L.) Elite Line 64-91

Ian Forbes, Jr., and Homer D. Wells (Tifton)

The worst hazard in the cultivation of blue lupine as winter annual forage and cover crops in the Southeastern United States is winter injury which occurs when temperatures fall below about 20° F. Complete loss of the crop has occurred after temperatures as high as 18° F, although the critical temperature is influenced by various other weather, plant, soil, and field site variables. Selection WH-1 from a wild Portugese introduction has survived temperatures as low as 1° F. It has been crossed with elite lines having resistance to anthracnose and gray leafspot, soft seededness, low alkaloid content, and variety-marking genes. Selection within the hybrid progenies for plants combining winterhardiness with the other desirable characters mentioned has been practiced in each generation since the F_2. In the 1965-66 winter after a record minimum temperature (6° F on Jan. 30, 1966) at Tifton, all 63 F_5 and F_7 selected lines had less winter injury than non-hardy varieties, and only 12 had more injury than the winterhardy control (WH-1). Results from laboratory tests showed that all lines were sweet, and all but two were soft seeded. Greenhouse inoculation studies showed that all except two lines were homozygous resistant to gray leafspot. Although perfect anthracnose evaluation was not obtained in greenhouse inoculations, 50 lines appeared to be homozygous or heterozygous for anthracnose resistance. Seed increase of the best lines has begun, and, following further selection and evaluation, they are expected to provide the basis for the first blue lupine variety with increased winterhardiness.

The greater winterhardiness of one such elite line, 64-91, was again observed in 1966-67 in replicated comparisons with Rancher blue as the non-hardy control. No injury occurred on 64-91 at Experiment, Georgia (9° F minimum); Tifton, Georgia (16.5° F), and Gainesville, Florida (18° F). Rancher was killed in the tests at all three locations. Line 64-91 is sweet (low-alkaloid), soft-seeded, resistant to anthracnose and gray leafspot, and marked with blue flowers and white seeds with tan specking. A grazing trial at Tifton in 1965-66 indicated that it was highly palatable to a beef brood-cow herd. Enough seed of this line will be available for small forage and seed yield trials by interested research workers in the fall of 1967.

Publications:

Forbes, Ian and Homer D. Wells. 1966. Rancher blue lupine--A disease-resistant forage variety. Ga. Agr. Res. 7(3):3-4.

Forbes, Ian, Jr., and Homer D. Wells. 1966. Breeding and characteristics of Rancher blue lupine. Proc. 63rd Ann. Conv. ASAW:80.

Forbes, Ian, Jr., and Homer D. Wells. 1966. Breeding blue lupine forage varieties for the South-eastern United States. Proc. X International Grassland Congr. Sec. 3:102-105.

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KENTUCKY

Plant Physiology Studies With Red Clover

W. A. Kendall (Lexington)

Growth of red clover pollen through excised pistils. Excised pistils (without the ovulary and enclosed in its stamen tubes) were laid in plastic caps with the stigmas protruding over the edge of the cap and the excised end submerged in nutrient media. The greatest pollen growth was obtained in media which contained 0.050 g Tween 20, 0.050 g boric acid, and 83 g raffinose per liter. The optimum temperature for pollen growth was in the range of 15 to 20° C. Pollen tubes grew through less than 1% of the pistils which had been self-pollinated and left intact on the plant, whereas pollen tubes grew through about 25% of the self pollinated pistils which were excised and cultured on the raffinose media at 15° C.

Seed production on excised flower stems. The technique described by Battle (Agron. J. 1949) for producing seeds on excised flower stems after compatible pollinations has been modified to enhance the formation of seed after self-pollination which is usually incompatible. The new technique consists of excising flower stems about 6 inches long with buds showing only a small amount of petal color. The stems are placed in jars with 2½% sucrose, and boric acid and Tween 20 at 50 ppm at 35° C until the florets open. When most florets have opened (about 2 to 4 days) they are self-pollinated and then incubated at 20° C for 24 hours to enhance pollen tube growth. After 24 hours at 20° C the cultures are transferred to 30° C for about two weeks Seed was obtained from about 10% of the florets in 40 out of a total of 45 different Kenland plants after self-pollination using this method. Further refinements of the technique are being studies.

Light quality studies. Studies of the effects of light quality (tungsten vs. fluorescent bulbs) during the entire or last 15 minutes of the photoperiod on rooting, type of growth, and persistence of clones of red clover are in progress. In the first experiment, each light source was used alone during the entire photoperiod, and clones which are known to differ under field conditions had a similar response to the light treatments.

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MARYLAND

Rooting Crownvetch Cuttings

Richard H. Hart (Beltsville)

When Cuttings from four clones of crownvetch were treated with "Rootone", 91, 79, 90, and 90% rooted. Without "Rootone", 100, 17, 34, and 59% rooted. Treated cuttings from the last two clones rooted more quickly than untreated, but cuttings from the first two did not. Because each clone responded differently, a "species response" cannot be defined, but "Rootone" did not significantly reduce rooting in any case. Therefore, we would recommend its use on crownvetch cuttings.

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Red Clover Research Conference

Robert C. Leffel (Beltsville)

A Red Clover Research Conference by public and private research workers was held at the Department of Agronomy, University of Kentucky, Lexington, on March 21 and 22, 1967. The objective of the Conference was to review past, current, and future research with red clover. A Report of the Conference may be obtained from R. C. Leffel, Room 335, South Building, Plant Industry Station, Beltsville, Maryland 20705.

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Effect of Tobacco Ringspot Virus on Growth, Vigor, and Seed Set in Birdsfoot Trefoil

Stanley A. Ostazeski (Beltsville)

In 1965 we reported the natural occurrence of tobacco ringspot virus (TRSV) in a birdsfoot trefoil clone, 2B-59, at Beltsville, Maryland. We have since positively identified strains of the virus from birdsfoot trefoil grown in Columbia, Missouri, and Blacksburg, Virginia. Like many other hosts when initially infected with TRSV, birdsfoot trefoil shows characteristically severe "shock" symptoms which gradually fade and disappear. The plants are then symptomless and cannot be distinguished visually from TRSV-free plants. We successfully inoculated plants of three other clones. After symptoms disappeared, we took vegetative cuttings from these and their virus-free counterparts and rooted them in test tubes of tap water. Roots of each cutting were counted and the longest root of each was measured. There was a highly significant difference between virus-free and virus-infected clones as to the number of roots produced per cutting as well as the length of the longest root.

Cuttings from this study were established in 4-inch pots, and the top growth was periodically cut back, dried, and weighed, and the yields were analyzed.

Here, too, there was a highly significant difference between virus-free and virus-infected clones. In the spring of 1966, a field planting was established of the same type of material. Vigor notes were taken on the basis of 1 to 9, where 9 was most vigorous and 1 was dead, or nearly so. Again we found the vigor of virus-infected plants to be significantly less than their virus-free counterparts. We are in the process of harvesting seed from select plants in this study, and we find that virus-infected plants yield few, if any, seed, while their virus-free counterparts are average seed producers.

It is of interest to note that Clone 2B-59, first discovered to be a carrier of TRSV, was also poor in seed set both in the field and in controlled crosses in the greenhouse. From another study we were able to obtain 50 seeds from Clone 2B-59 to check seed transmission of TRSV. One seedling (2%) which was symptomless was positively infected with TRSV--a rate high enough to perpetuate and spread the virus quite adequately. We anticipate harvest of enough seed from virus-infected plants in current studies to determine more thoroughly the rate of seed transmission of the virus.

Insect vectors of TRSV are not known. However, in other crops certain nematode species are capable of transmitting the virus. In most crops we would expect plant-to-plant transmission by nematodes to be rather slow, unless nematode populations were abnormally high and suscept plants were close together. It is interesting to speculate whether or not infected weed hosts of the virus, or high nematode vector populations, or both, could be factors in build-up of TRSV in birdsfoot trefoil following birdsfoot cropping sequences.

The observations serve to emphasize that TRSV-infected plants, though virtually symptomless, are deleteriously affected by the virus; that our limited observations show that TRSV is seed transmitted in birdsfoot trefoil; and that TRSV probably occurs wherever birdsfoot trefoil is grown.

References:

Ostazeski, S. A.
1966. *Thielaviopsis basicola* on greenhouse-grown birdsfoot trefoil (*Lotus corniculatus*). Pl. Dis. Rptr. 50:825-827.

Ostazeski, S. A. and H. A. Scott
1966. The natural occurrence of tomato ringspot virus in birdsfoot trefoil. Phytopathology 56:585-586.

MICHIGAN

Three Annual Legumes for Potential Use in Northern Michigan

H. L. Kohls and F. C. Elliott (East Lansing)

Introduction of a number of legume genera and species from many agricultural areas of the world have been tested at the Lake City Station. From the introductions and from crosses made, a few selections of Lupinus angustifolius, Lupinus albus, and Vicia sativa have given preliminary results that are promising for soil improvement and high protein forage and feed supplements for livestock. Seed increases of these selections are being made for further testing in Northern Michigan. (Abstract--Mich. State Univ. Quart. Bul. 48(3):365-368. 1966)

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MISSISSIPPI

Breeding and Genetics, Diseases, Quality and Varietal Evaluation, and Culture and Physiology of Annual Species of Clovers for Hay, Pasture, Seed, and Soil Improvement

William E. Knight (State College)

Objectives: (1) To develop improved methods of breeding winter annual clovers; (2) To determine inheritance and nature of action of genes conditioning specific characters; (3) To produce interspecific hybrids among species; (4) To breed and evaluate winter annual clover for increased production, quality, winter hardiness, and insect and disease resistance; and (5) To develop cultural and management techniques for more efficient production of winter annual clovers.

Progress Attained: Genetic studies are progressing on the following characteristics: Glabrous leaves with leaflets extended, glabrous leaves with normal leaflet attachment, pubescent leaves with leaflets extended, multiple leaflets, and male sterility caused by absence of anthers. Selection is continuing for flower and seed color variations, non-shattering of seed, and purple plants. The inheritance of flower color is the only one of these characteristics described in the literature. The results of this research should contribute to the overall knowledge of this specie as well as provide simply inherited markers for future genetic studies. F_2 seed was produced in the greenhouse in 1965. Segregating populations are being grown, and results of these studies should be summarized and published in 1967.

The results from inbreeding and polycross testing indicate that superior recombinations of crimson clover inbred lines can be found that exceed existing varieties in forage yield, in uniformity, and which possess other desirable agronomic characteristics.

Comparative reseeding and forage production of crimson and arrowleaf clovers was investigated in a Coastal bermudagrass sod. Autauga and Chief crimson clover varieties produced significantly more forage than Frontier crimson or Yuchi arrowleaf clovers. Average seedling counts from volunteer stands were 99, 96, 69, and 57 seedlings per spare foot for Autauga, Chief, Frontier, and

Yuchi, respectively. Results indicate that satisfactory reseeding can be obtained from arrowleaf clover but that this specie is sensitive to spring defoliation. The main forage production and blooming of arrowleaf occurs after May 1. Therefore, close attention to clipping and grazing management are needed to provide adequate quantities of seed for volunteer fall stands. Autauga and Chief crimson clover varieties averaged 2,820 pounds of dry clover forage per acre, and an average total yield of grass and clover of 12,140 pounds of dry forage per acre. Arrowleaf clover produced 2,280 pounds of clover and 11,260 pounds of clover and grass. Spring forage production was much less from arrowleaf clover than from crimson clover. Forage production from annually seeded clovers compared favorably with forage yields from volunteer stands.

The effect of spring defoliation on self-reseeding of arrowleaf, crimson, and sub clovers was studied in clover stands which had been established in Coastal bermudagrass. Sub clover reseeded well regardless of spring clipping treatment. Volunteer stands of all other species were adversely affected when forage was harvested on April 25. Average reseeding for three dates of spring clipping was best from Autauga and Chief crimson clover varieties. Crimson clover grown with Coastal bermudagrass increased total production of clover and grass 215% over the yield of the check plot without clover. Arrowleaf clover grown with Coastal bermudagrass increased total forage production 160% compared to the no clover check plot.

High-temperature dormancy in crimson clover has been investigated using standard laboratory germinators and procedures. The material tested represented inbred lines and polycrosses from the Dixie and Chief varieties and inbred lines from 9 plant introductions. The results of this research suggest that some crimson clover genotypes possess high-temperature dormancy in addition to dormancy resulting from an impermeable seed coat. Selection for high-temperature dormancy has apparently accompanied the selection for an impermeable seed coat in the development of the hard-seeded varieties. Several inbred lines exhibited high-temperature dormancy at different stages of inbreeding and as polycrosses. This behavior suggests genetic control of this characteristic. Incorporation of high-temperature dormancy into a reseeding crimson clover variety should reduce the hazard of stand losses during the summer and should widen the area of adaptation and usefulness of this crop. Screening of seed lots will be carried out to isolate lines possessing this characteristic. High-temperature dormancy has not been previously reported in crimson clover, although it has been found in other Trifolium species. High-temperature dormancy was effectively broken by transferring seed from high to low temperatures.

Cooperative work has been initiated with Dr. H. W. Johnson, Delta Branch Experiment Station on diseases of the annual clovers. Collection of diseased plant material has been made. Inbred crimson clover lines will be screened for reaction to Sclerotinia trifoliorum Eriks.

Publications:

Knight, W. E. 1966. Comparative reseeding and forage production of crimson and arrowleaf clovers grown in a Coastal bermudagrass sod. 63rd Proc. Sou. Agr. Workers.

Knight, W. E. 1967. Effect of seeding rate, fall disking, and nitrogen level on stand establishment of crimson clover in a grass sod. Agron. J. 59:33-36.

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White Clover Variety Trials

V. H. Watson, C. W. Thurman, and C. Y. Ward (State College)

One of the greatest pasture needs of the South has been and still is a more persistent legume for grazing. In four years of testing at State College, Regal represents the highest yielding White clover variety available to Mississippi farmers today. Regal has been equal to or exceeded all commercial White clover varieties in yield, disease resistance, drought tolerance, and longevity. Regal and Tillman (a new variety released jointly by South Carolina and the USDA) are particularly superior to Louisiana S-1 White clover in forage production during the hot summer season.

The experiment mentioned above was established in the fall of 1962 on a Leeper fine sandy loam soil at State College, Mississippi. Varieties--Regal, Louisiana S-1, Tillman, Espanso, and Commercial Ladino white clovers--were planted alone and with Kentucky 31 tall fescue (Festuca arundinacea Schreb.). The clovers were seeded at the rate of 3 pounds per acre and Kentucky 31 tall fescue was seeded at 15 pounds per acre.

All plots were fertilized annually with 0-120-120 (N-P_2O_5-K_2O) per acre. Forage was harvested when the clover was six to ten inches tall (three times in 1963, five times in 1964, seven times in 1965, and four times in 1966).

Data in Table 1 indicate that all Ladino type white clover varieties outyielded Louisiana S-1 whether grown alone or in a mixture with tall fescue. In 1963, the dry matter yield of Regal was more than 10 times greater than that of Louisiana S-1 when grown alone and twice as great when grown with tall fescue. Likewise, in 1964, 1965, and 1966, Regal outyielded Louisiana S-1 by 1 to 2 tons per acre whether grown alone or with tall fescue. The total yield for Tillman, Espanso, and Ladino were similar to that of Regal but their midsummer production and persistence were inferior to that of Regal during the four years of the experiment. Regal has also persisted well under grazing at the Brown Loam Branch Experiment Station near Jackson, Mississippi.

The large volume of seed produced by Louisiana S-1 white clover probably accounts for its greater persistence in pastures than many other white clovers. Notes made on flower production, as an indicator of reseeding ability, show that Regal produces an abundance of flowers, but fewer than Louisiana S-1. The greater ability of Regal to survive year after year seems to stem from its greater drought and heat tolerance as well as disease resistance.

Table 1. Dry matter yield in pounds per acre for five varieties of white clover grown alone and with tall fescue at State College, Miss.[1/]

Variety	Dry Matter Yield - Lbs/A Alone (Pure Stand) 1963	1964	1965	1966	4-Yr. Avg.
Louisiana S-1	218	6212	5957	2952	3835
Regal	3842	10364	9413	5992	7403
Tillman	3463	9872	8549	4838	6680
Espanso	4436	9368	7990	5030	6706
Ladino	4151	8957	8514	5194	6704
	With Tall Fescue[2/]				
Louisiana S-1	2379	6044	8355	3125	4976
Regal	4757	10803	10466	5846	7968
Tillman	5103	10012	9555	5064	7434
Espanso	5375	10624	9386	5742	7782
Ladino	5508	10012	9494	5470	7621

1/ P_2O_5 and K_2O applied uniformly at 120 pounds per acre annually.

2/ Yield includes the tall fescue.

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Species Evaluation and Adaptability Experiments With Miscellaneous Annual Clovers

C. W. Thurman and C. Y. Ward (State College)

The growing of adapted pasture legumes in the South, whether annual or perennial has long been a problem. During 1965, in an attempt to screen some 35 miscellaneous annual clovers, an experiment was initiated to evaluate the adaptability and yield potential of some 35 varieties and/or species of annual clovers at State College, Miss. (Table 1). These clovers were planted by broadcasting the seed by hand after mixing with the proper inoculant. The 5 by 12' plots were cultipacked immediately after planting. Planting occurred on October 20, 1965, following the incorporation of 0-60-60 (N-P_2O_5-K_2O) per acre. No weed control measures were used either at planting or throughout the duration of the experiment since the experiment was established on an area that had been fallowed and was relatively weed free. Little weed encroachment was present throughout the duration of the study. Adequate stands of most of the clovers were obtained, but little fall or early winter grazeable or harvestable herbage resulted from varieties in this study. The soil type was a Leeper fine sandy loam near State College, Miss., and the experimental design was a Randomized Complete Block with four replications. Forage was harvested with a sickle bar mower on May 30, 1966. Seven of the species encompassing varieties of Persian, berseem, arrowleaf, and big flower clover regrew sufficiently to merit a second

harvest on June 29, 1966. The first harvest date was too late to obtain maximum yields of the crimson clover varieties as they were already in an advanced stage of maturity in which mature seed heads were formed and most of the plants were essentially dead. Most of the other varieties were in a full bloom stage of maturity when harvested.

In general, the sweet clovers were the top yielders followed by varieties of Persian, rose, and berseem clover. The arrowleaf and crimson clover varieties were in the same general yield range, whereas the subclovers were, in general, the lowest yielders with little measureable yield accumulating throughout the entire growing season. It was noted that Florama sweet clover yielded 9500 pounds of dry matter per acre on a single harvest. This harvest occurred when when the clover was approximately 8 feet tall. This variety reached a height of approximately 11 feet by August following establishment in October, and forage from this variety stayed green from the time of emergence in November, 1965, until October of the following year. When plots were harvested the first time, only the 30-inch yield strip was removed from the plot, and the borders were allowed to grow in order to facilitate observational note taking on the clovers as they progressed through advanced stages of maturity. From these data it was noted that the sweet clovers may have a place in southern agriculture as either hay or grazing crops due to their tremendous yield potential. However, the plants are rather stemmy which results in a relatively low quality forage compared to low growing succulent clovers or alfalfa. The ball clovers may have possibilities under grazing conditions as do the arrowleaf and crimson clovers. However, the subclovers, even though it is apparent they would survive in a grazing situation, had a yield potential so low they probably have little place in southern agriculture. Similar tests will be established this fall encompassing clovers other than those listed for this experiment.

The clovers are arranged by species, and under each species the varieties are listed in alphabetical order and not in descending order of yield (Table 1).

Table 1. Dry matter yield in pounds per acre of annual legumes tested at State College, Mississippi, 1966.

Variety	F.C. Number	Yield		
		1st Harvest 5/30/66	2nd Harvest 6/29/66	Total
Arrowleaf Clover (Trifolium vesiculosum)				
Amclo	38,516	1707	38	1745
Late (Meechee)	38,517	2574	--	2574
Yuchi	38,515	2474	251	2725
Ball Clover (Trifolium nigrescens)				
Common	36,942	3143	---	3143
Giant	38,525	1266	---	1266

Table 1. Continued

Variety	F.C. Number	Yield 1st Harvest 5/30/66	Yield 2nd Harvest 6/29/66	Yield Total
Berseem (Trifolium alexandrinum)				
Common	38,506	2944	---	2944
Hustler	38,507	2232	855	3087
Misgawi	38,562	2413	419	2832
Nile	38,508	3022	718	3740
Big Flower Clover (T. michelianum)	38,523	1736	34	1770
Cluster Clover (T. glomeratum)	37,926	93	---	93
Crimson Clover (T. incarnatum)				
Auburn	38,514	1173	---	1173
Autauga	38,535	1608	---	1608
Chief	38,502	1206	---	1206
Dixie	38,556	1493	---	1493
Domestic	38,504	1372	---	1372
Frontier	38,503	1265	---	1265
Talladega	37,388	1439	---	1439
Hop Clover				
Big Hop (T. procumbens)	37,406	2768	---	2768
Small Hop (T. dubium)	37,730	324	---	324
Lappa Clover (T. lappaceum)	32,190	2383	---	2383
Persian Clover (T. resupinatum)				
Abon	38,524	4877	292	5169
Common	38,505	1723	---	1723
Rose Clover (T. hirtum)	38,528	4208	---	4208
Subclover (T. subterraneum)				
Bacchus Marsh	38,557	118	---	118
Clare	36,586	89	---	89
Dualgamp	34,290	48	---	48
Mt. Barker	38,588	294	---	294
Nangeela	36,831	323	---	323
Tallarook	36,840	199	---	199
Yarloop	36,585	104	---	104
Striata Clover (T. striatum)	37,925	77	---	77
Sweetclover (Melilotus spp.)				
Floranna	38,374	9592	---	9592
Hubam	38,373	8579	---	8579
Israel	38,518	4110	---	4110

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NORTH CAROLINA

A New Korean Lespedeza Named Yadkin

Will A. Cope (Raleigh)

Korean lespedeza has received first attention in the research project entitled "Evaluation and Breeding to Develop Acid-tolerant Strains of Annual Lespedeza". Korean lespedeza was used without selection for two decades after its original introduction. In 1945 the North Carolina program was begun to improve common types. First consideration was given to improving forage yield. Then, after nematode and tar spot problems developed, disease resistance was more important.

Yadkin lespedeza was released in 1966 in cooperation with the North Carolina Agricultural Experiment Station. This new variety should fill the need for a Korean lespedeza with greatly improved seed yield. Lespedeza acreage has been declining in North Carolina for a number of years; reduced seed yields caused by tar spot infection has been an important factor. Tar spot is present in practically all Korean fields, causing heavy defoliation before the critical late season seed production period.

Yadkin presently has acceptable field resistance tar spot as well as the root-knot nematode resistance of the Rowan variety. It is 10 days to 2 weeks later in both flowering and seed maturity than ordinary Korean. Yadkin has an upright growth habit similar to that of Climax and a relatively light flower color which makes varietal identification possible.

In 1966 Yadkin was in the F_{10} generation, representing selections from one F_2 plant from the cross of the experimental line N.C. 128 x Auburn Korean. The N.C. 128 parent was in the F_{10} from the cross Rowan x F.C. 31,850; Auburn Korean was an Alabama selection. N.C. 128 had the Rowan root-knot resistance and a light flower color; Auburn Korean had tar spot resistance. Both parents were late maturing lines with high forage production. F_2 families were evaluated for yield and tar spot resistance for several years. The most promising family was tested in F_6 and F_7 for resistance to Meloidogyne incognita. Twelve plants were selected for resistance and seed increase was made. Breeder seed of Yadkin consists of equal parts of seed from each of the 12 lines. The 12 lines will be maintained by the North Carolina Agricultural Experiment Station.

Over a period of years, Yadkin has yielded twice as much seed and 20% more forage than varieties presently grown in North Carolina. In strain tests in adjacent states, Yadkin was always close to the top, indicating adaptability to the whole eastern Korean-producing area.

Publications:

Cope, W. A. 1966. Cross-pollination in sericea lespedeza. Crop Sci. 6:469-470.

Cope, W. A. 1966. Growth rate and yield in sericea lespedeza in relation to seed size and outcrossing. Crop Sci. 6:566-568.

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NORTH DAKOTA

Production and Management of Clover, Trefoil, and Minor Forage Legumes in North Dakota

Kenneth L. Larson (Fargo)

Research relating to production and management of clover, trefoil, and minor forage legumes in North Dakota is supported by H-6-3, Evaluation of Forage Crop Species.

Birdsfoot trefoil. Limited acreage of birdsfoot trefoil is restricted to the Red River Valley in eastern North Dakota where its primary purpose is for seed production. Seed yield from 7 varieties in experimental plots at Fargo during 1966 averaged 200 pounds clean seed per acre. Forage production from the same varieties harvested twice averaged 3.3 tons dry matter per acre.

Red clover. Red clover acreage also is restricted to eastern North Dakota where rainfall is more favorable than to the west. Red clover research has been designed to study forage-seed production from 2 harvests as compared to seed production from one harvest. Forage and seed yields from 8 varieties harvested twice from experimental plots at Fargo during 1966 were 2.04 tons dry matter and 176 pounds clean seed per acre, respectively. Seed produced from varieties harvested once was 154 pounds clean seed per acre.

Sainfoin (Onobrychis viciaefolia). Observations at the North Dakota Agricultural Experiment Station approximately 20 years ago suggested several sainfoin strains available at that time were not adapted to North Dakota conditions. However, recent interest has resulted from work conducted with the variety Eski at the Montana Agricultural Experiment Station where it was shown to have promise for hay on dryland.

A small observation plot of Eski was seeded at Fargo on May 10, 1965. The plants were allowed to grow undisturbed throughout the summer and fall of 1965. Winter survival over 1965-66 was excellent.

The plants were sampled during several stages of growth in 1966. Tops and roots were separated at a point 1 1/2 inches above the cotyledonary node. The tops and four inches of root extending below the cotyledonary node were retained for protein analyses and were dried at 100° C for 1 hour and to constant weight at 70° C.

Good nodulation was observed on the roots. Seeds were inoculated with the proper nitrogen fixing bacteria at the time of seeding.

Data in the following table show percent protein in the roots and tops at various stages of growth.

Table 1. Percent protein in roots and tops of sainfoin at various stages of growth

Sampling date	Stage of growth	% Protein	
		Tops	Roots
May 18	Rosette, 3" tall	34.2	15.2
June 7	80% bud, 21" tall	20.0	9.7
June 22	50% bloom, 31" tall	10.6	9.5
July 5	Full bloom, 32" tall	10.5	6.9
July 26	Seed	8.1	8.5
August 15	Pods falling	9.3	8.6

Recovery growth of sainfoin was very poor.

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OHIO

Crownvetch Studies

R. W. Van Keuren (Wooster)

1. Crownvetch variety test.

   a. Project: State 353, subproject CV-61-W
   b. Location: Wooster, Ohio
   c. Planting information:
      (1) Band seeded April 1961 without a companion crop
      (2) 10# seed per acre with 300# 0-20-20
      (3) Initial high level of P and K, pH 7.0
      (4) Annual applications of 300# 0-20-20
   d. Stand not sufficiently good to harvest for yield until 1964
   e. Yield, tons per acre of dry matter[1/], two cuttings annually.

Variety	1964			1965			1966			3-yr. Avg.
	6/8	8/17	Total	6/7	8/17	Total[2/]	7/15	8/31	Total	
Chemung	2.22	.76	2.97	1.83	.41	2.24 b	2.36	.76	3.11	2.77
Emerald	2.10	.83	2.93	2.13	.52	2.65 a	2.36	.86	3.22	2.93
Penngift	1.93	.79	2.72	2.41	.44	2.85 a	2.50	.73	3.23	2.93
Michigan 124	1.91	.76	2.67	2.11	.45	2.56 ab	2.42	.77	3.19	2.81

1/ No significant difference in yields within years ($P > .05$) except in 1965.

2/ Duncan's multiple range test ($P < .05$).

   f. Comments: Stands and yields have generally improved over the years.

2. Crownvetch variety test.

a. Project: State 353, subproject CV-63-W
b. Location: Wooster, Ohio
c. Planting information:
(1) Band seeded April 1963 without a companion crop
(2) 10# seed per acre with 300# 0-20-20
(3) Initial high level of P and K, pH 6.3
(4) Annual applications of 300# 0-20-20
d. Yield, tons per acre of dry matter, two cuttings annually[1/].

Variety	1964[2/]	1965			1966			3-yr.
	8/18	6/7	8/17	Total	7/15	8/31	Total	Avg.
Chemung	1.52	2.56	.94	3.50	2.35	1.37	3.72	2.91
Emerald	1.70	2.51	.98	3.49	2.42	1.34	3.76	2.98
Penngift	1.22	2.21	.84	3.05	2.41	1.34	3.75	2.67

1/ No significant difference in yields within years ($P > .05$).

2/ First growth stand too uneven to harvest for yield.

e. Comments: Stand and yield improved over the years.

3. Crownvetch persistence and yield under grazing.

a. Project: Hatch 271, subprojects S-271-CV and SE-271-CV
b. Locations: S.E. Branch, Albany, and Southern Branch Ripley, Ohio
c. Planting:
(1) Band seeded April 1963 at both locations with 300# 5-20-20, following liming.
(2) Excellent stand obtained at S.E. Branch and a satisfactory stand at Southern Branch despite very dry conditions establishment year.
d. Grazing:
(1) Stands at both locations suitable for grazing year following establishment
(2) Grazed twice each year with beef cows and their calves (March dropped)

(3) Grazing summary:

	Beef cow and calf days* PER ACRE			
	1964	1965	1966	3-yr. Avg.
Southeastern Branch	124	196	117	146
Southern Branch	60	101	72	78

*The grazing unit is a mature beef cow and her calf.

e. Comments: There has been no problem of acceptibility by the cattle. Neither stand has much grass although timothy was seeded in both. The stand at Southeastern on a well-drained Brooke-Upshur silty clay loam continues to be very good, with very little weed encroachment. The stand at the Southern Branch on a moderately well-drained Rossmoyne silt loam appears to be thinning and weed encroachment was quite marked in 1966.

Publications:

Van Keuren, R. W. 1966. Stocking rate and companion grazing on Kentucky bluegrass-trefoil pastures. Ohio Agr. Res. and Dev. Ctr. Res. Summary 11: 15-18.

Davis, R. R. and R. W. Van Keuren. 1966. Birdsfoot trefoil pasture for Northeastern Ohio. Ohio Agr. Res. and Dev. Ctr. Res. Summary 12:22.

Van Keuren, R. W. and C. F. Parker. 1966. How stocking rate affects pasture gains. Ohio Report 51(6):88-89. (Study on bluegrass-trefoil pastures)

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SOUTH CAROLINA

Breeding and Genetics, Diseases, Quality and Varietal Evaluation, and Culture and Physiology of Perennial Species of Clovers for Hay, Pasture, Seed, and Soil Improvement

Pryce B. Gibson (Clemson)

Species hybrids. Plants from several seed lots of Trifolium nigrescens Viv. were screened for compatibility with T. occidentale D. Coombe. Two compatible plants were found among plants from P.I. 210,354, an introduction from Italy. The compatibility of these plants with other species was explored. Plants were obtained from crosses with T. hybridum L. and T. repens L. In all crosses, the nigrescens plant was used as the pistillate parent. Also, plants were obtained from the cross T. repens x T. occidentale.

In the crosses with T. nigrescens (2N=16) and T. repens (2N=32) the use of pollen from colchicine-induced tetraploid T. occidentale plants resulted in a higher incidence of seed set than the use of pollen from diploid T. occidentale (2N=16) plants.

Although excised ovules were cultured on artificial media to obtain some of the hybrid plants, most of the plants were grown from seed germinated in sand. However, each of the three plants of one cross, T. hybridum x T. occidentale, resulted from excised ovules. These plants have not flowered and the cross has not been verified

Hybrid plants generally display varying percentages of aborted pollen and varying degrees of chlorosis. Based on limited data, one backcross to either parent results in normal green color of most plants.

The successful crossing of these species provides genetical support to their close taxonomic relationship. It also verifies the possibility of transferring desirable characteristics among the related species. The morphological traits of T. nigrescens and T. occidentale and of their hybrid progeny suggest that these two diploid species may be ancestral parents of the tetraploid species T. repens.

Flowering requirements of Trifolium occidentale D. Coombe. The flowering of T. occidentale, T. nigrescens Viv., and T. repens L. was compared. Young seedling plants of each species were preconditioned for 4 weeks at 50° and 70° F in a light regime of 10 hours light and 14 hours dark (10L:14D). Then, plants from each environment were assigned to each of the 4 light and temperature regimes. The number of flower heads produced per plant was recorded for the next 11 weeks.

Preconditioning Environment			Growing Environment		
P1.	50° F	10L:14D	G1.	50°	11L:6D:1L:6D
P2.	70° F	10L:14D	G2.	50°	12L:12D
			G3.	70°	11L:6D:1L:6D
			G4.	70°	12L:12D

The only plants of T. occidentale that flowered profusely were those preconditioned at 50° F (P2) then grown at 70° F with a light regime of 11L:6D:1L:6D (G3). Apparently, flowering of T. occidentale is influenced by preconditioning at a low temperature and by the photoperiod-temperature regime at which it is grown.

In this test the flowering of T. nigrescens depended primarily upon the size of the plants. The flowering of T. repens depended primarily upon photoperiod but also responded to preconditioning at a low temperature.

Tolerance to root-knot nematodes in T. repens L. Several clones of T. repens have been selected in the past few years for tolerance to root-knot nematodes. From the clones selected for tolerance, two sets of 6 clones each were chosen and were crossed factorially. The first year's data from the 36 crosses indicate that tolerance is largely determined by general combining ability.

Publications:

Gibson, Pryce B. and E. A. Hollowell. 1966. White Clover. U. S. Dept. Agr. Agricultural Handbook No. 314, 33p.

Trautner, James L. and Pryce B. Gibson. 1966. Fate of white clover axillary buds at five intensities of sunlight. Agron. J. 58:557-558.

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TEXAS

Forage Legume Research in the Texas Gulf Coast Prairie

R. H. Brown, J. P. Craigmiles, and J. R. Wood (Beaumont)

A 2-crop system of agriculture--rice and pasture--is used in the Gulf Coast Prairie of Texas. Historically, these poorly drained soils produced grass and sedge abundantly with the forage frequently growing head high. In recent years, results of forage research have enabled legumes to flourish. Today, dallisgrass and white clover are the predominating forage species. Clovers, such as Persian, bur, ball, and white, grow abundantly. This report summarizes the present legume research activities at the Beaumont Center.

The clover improvement program has been concerned primarily with Persian clover, resulting in the release of Abon in 1964. Israel sweet clover (Melilotus alba) is also a product of the clover breeding program. A limited program for improving hard seed production, winter hardiness, and forage production of berseem clover (T. alexandrinum), Persian clover (T. resupinatum), Giant ball (T. nigrescens), and Mike clover (T. michelienum) has been underway for several years.

Clover grazing trials. Grazing trials, evaluating the relative value of three clovers in combination with Gulf ryegrass, has been conducted for four years. Berseem (T. alexandrinum), Giant ball (PI 206,926, T. nigrescens), and Abon Persian (T. resupinatum) were seeded the middle of September with 20 pounds of Gulf ryegrass per acre. Sixty pounds of P_2O_5 per acre were applied by plane in November. Grazing began usually in early December and continued to late May or early June. A maximum fluctuating stocking rate was used to obtain good forage utilization. Ryegrass and ball clover produced 328 pounds of beef per acre; ryegrass and Abon, 315 pounds; and ryegrass and berseem, 299 pounds per acre per year.

White clover variety trials. Several varieties of white clover have been seeded each fall since 1963. The stands have been maintained since that time to evaluate persistence. The difference in dry matter yields between varieties have been generally small. Ladino has given the lowest yields, and Regal, Tillman, La. S-1, and Nolin's Improved have been about equal in production, averaging 11,000 lbs/A of dry forage during 1966. La. S-1, over the years, has been the heaviest forage producer. Its prolific seed-producing ability assures reseeding in case disease or unfavorable weather conditions eliminates the parent plant.

Influence of seeding date and height and frequency of clipping Gulf ryegrass, berseem clover, Abon Persian clover, and La. S-1 white clover. These four forages were seeded at approximately 15-day intervals beginning September 1 and ending December 1 for three years, starting in 1962. In another study four mowing frequencies at 1, 2, 3, and 4 weeks and two clipping heights--2 and 5 inches--were made as systematically as weather and forage permitted.

Results show the more frequently the plants were cut the lower the production, but closer clipping gave increased yields at essentially all clipping intervals. Therefore, maximum yields were obtained with infrequent close clipping.

White clover appears to be less sensitive to clipping frequency than the other forages with the greatest yield obtained from the 4-week clipping interval and a 2-inch clipping height.

Results from date of seeding studies show that the optimum time to seed clovers is October 1-15, although, if moisture is available for seed germination, maximum early forage production can be obtained at an earlier seeding date since seeding early provides more early forage. Gulf ryegrass, with moderate amounts of nitrogen, was the most productive of the four winter forages tested, followed in descending order by Abon Persian, La. S-1, and berseem. Under droughty conditions, forage production of La. S-1 is noticeably reduced, whereas Abon appears to be more drought tolerant.

A January low of 15° F resulted in a loss of berseem and damage to Abon Persian and La. S-1 white.

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VIRGINIA

Combining Ability For Seed Yields in Birdsfoot Trefoil

John D. Miller (Blacksburg)

This work was done under Line Project CR-c3-10, "Cytogenetics, breeding behavior, and taxonomic relationships of Lotus." Four clones used in several other studies were crossed reciprocally on three dates. Among the factors observed were numbers of florets per umbel crossed, number of umbels setting seed, number of seed per umbel, and weights of seed. Significant differences between dates were found for all characters studied. The midwinter date was poorest in all aspects of seed yield. Diallel analysis was applied for seed weights, seed per floret, and percent successful crosses. Significant differences were found between crosses for all three characters. General combining ability was involved in seed weight and percent successful crosses. Reciprocal differences were present for seed per floret.

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WISCONSIN

Adaptation of Forage Species in the State of Rio Grande do Sul, Brazil: Crimson and Subterranean Clover[1/]

Aino Jacques and Ruben Markus (Federal University of Rio Grande do Sul), and Paul Drolsom (Madison)

Limited availability of livestock feed in winter is one of the factors hindering the expansion of meat production in southern Brazil. The warm-season grasses generally provide feed for substantial weight gain during the summer, but cool temperatures and occasional frosts severely restrict growth of these species during winter.

1/ USAID Contract la-147, University of Wisconsin, College of Agriculture, and the Federal University of Rio Grande do Sul, Faculty of Agriculture and Veterinary, Porto Alegre, Brazil.

The objective was to evaluate performance during the winter of Trifolium incarnatum and T. subterraneum at 30° south latitude in Brazil.

Seven cultivars each of crimson and subterranean clover were seeded in separate randomized block trials, with 2x5m plots in 3 replications in mid-May 1965. The plot area, a sandy loam with a pH of 5.3, had a cover crop of cowpeas during the summer of 1964-65. The area was in native pasture preceding this. Immediately prior to seeding, 4000 kg of lime, 170 kg KCl, and 500 kg 20% superphosphate, on a per hectare basis, were broadcast with a Gandy spreader and disced into the soil. Plots were seeded broadcast by hand and raked.

Results:

Crimson clover. A summary of data is presented in table 1. The cultivars separated into 3 groups on the basis of dry matter production. Common and Dixie cultivars did not establish well and consequently yielded poorly. Frontier looked excellent all season and was superior in yield when clipped at anthesis. The other cultivars performed similarly. Diseases were not evident.

Although seed production was abundant in the spring of 1965, there was practically no re-establishment in 1966. Abnormally high rainfall during the summer and early fall, plus an extremely dry late fall, may have resulted in this behavior.

Subterranean clover. Data are presented in table 2. The better cultivars for dry matter production had the best-appearing early stands and vigor, except for Clare. A late December harvest for yield was taken but only Tallarook produced measurable recovery growth. Moisture conditions and management the previous season both may have contributed to poor re-establishment in the fall of 1966.

Summary:

Certain cultivars of both species merit further consideration as sources of winter feed. Presently there is lack of information concerning management aspects, especially fertility requirements, in order to obtain maximum benefits.

Table 1. Performance of 7 crimson clover cultivars at Centro Agronomico, Guaiba, Rio Grande do Sul, Brazil, in 1965.

Cultivar	June 25[1] Vigor	June 25[1] Stand	July 29[1] Vigor	July 29[1] Stand	October 20 Dry matter kg/ha [2]
Frontier	1.0	1.3	1.0	1.0	4119 A
Auburn	2.3	2.3	3.0	1.5	3311 B
Autauga	1.7	1.3	1.0	1.5	3302 B
Chief	1.3	1.3	1.0	1.0	3208 B
Talladega	3.0	3.0	2.0	2.5	3023 B
Common	3.3	5.0	4.5	4.0	1487 C
Dixie	3.3	5.0	4.0	5.0	1175 C
				CV(%)	7.7

1/ Rating scale: 1-best, 5-poor.

2/ Strains not opposite the same letter are significantly different in dry matter production.

Table 2. Performance of 7 subterranean clover cultivars at Centro Agronomico, Guaiba, Rio Grande do Sul, Brazil, in 1965.

Cultivar	June 25[1] Vigor	June 25[1] Stand	July 29[1] Vigor	July 29[1] Stand	October 20 Dry matter kg/ha [2]
Bacchus Marsh	2.7	2.7	2.0	2.0	2927 A
Yarloop	1.7	2.3	3.0	2.0	2853 AB
Clare	2.3	4.0	3.0	4.0	2807 AB
Mt. Barker	1.7	2.3	1.0	2.0	2571 AB
Nangeela	1.7	2.7	2.0	3.0	2142 BC
Tallarook	3.3	3.0	3.0	3.0	1529 C
Dwalganup	3.7	4.0	3.0	3.0	607 D
				CV (%)	17.2

1/ Rating scale: 1-best, 5-poor.

2/ Strains not opposite the same letter are significantly different in dry matter production.

SPECIES INDEX